

TECHNICAL REVIEWERS' RATING SUMMARY

R040-B

Onsite Installation of Secure, Remote, Autonomous, Multi-Drone Operations
within the ND Renewable Energy Sector

Evolve Analytics, LLC

Principal Investigator: Joshua Riedy

Request for \$500,000; Total Project Costs \$1,403,256

Rating Category	Weighting Factor	Technical Reviewer			Average Weighted Score
		1B	2B	3B	
1. Objectives	9	4	5	4	39.00
2. Achievability	9	2	3	3	24.00
3. Methodology	7	3	4	3	23.33
4. Contribution	7	3	5	3	25.67
5. Awareness	5	1	4	4	15.00
6. Background	5	5	4	3	20.00
7. Project Management	2	1	5	4	6.67
8. Equipment Purchase	2	3	5	4	8.00
9. Facilities	2	5	5	4	9.33
10. Budget	2	3	5	4	8.00
Average Weighted Score		150	215	172	179.00
Maximum Weighted Score					250.00

OVERALL RECOMMENDATION

FUND		X	X
FUNDING MAY BE CONSIDERED	X		
DO NOT FUND			

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Renewable Energy Sector

Submitted by Evolve Analytics, LLC

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- 1. The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Renewable Energy Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.**

Reviewer 1B (Rating: 4)

Objective: Product development to do

- Wildlife Mortality Monitoring and Mitigation
- Inspection and Maintenance
- Safety and Security

Claims: First of its kind, revolutionizes inspection efficiency.

How they substantiate the claims is vague. They link these objectives to the outcomes desired by the Renewable Energy Council.

Reviewer 2B (Rating 5)

The proposal would develop a solution that would be directly applicable to the renewable energy industry of North Dakota

Reviewer 3B (Rating4)

The objective of this proposal is to create a drone-based system to automate inspection and to automate inspection and maintenance operations in the North Dakota Renewable Energy Sector. This “Enterprise Autonomy” involves the commercial deployment of a remotely operated, autonomous, multi-drone fleet, powered by solar energy. It could improve the efficiency of asset inspection and maintenance and enhance other operational aspects such as safety, security, and wildlife monitoring. Once completed, it could also lead to improved scalability and accuracy compared to existing solutions. This could reduce operating costs (e.g., related to wildlife monitoring) and potentially increase power generation.

- 2. With the approach suggested and time and budget available, the objectives are: 1 – not achievable; 2 – possibly achievable; 3 – likely achievable; 4 – most likely achievable; or 5 – certainly achievable.**

Reviewer 1B (Rating: 2)

There is not enough specificity for me to say the objectives are likely achievable. There is a description of the subordinate tasks, but it is not clear what portions of the time and budget are allotted to these task. After of a description of the tasks, the budget and schedule seem to use different labels. Even if the labels were linked, there is no explanation of the time and budget standards used to arrive at the schedule and budget.

Reviewer 2B (Rating: 3)

This proposal doesn't require any breakthrough technology development or "hard science" effort, which lends credibility to their plans and their ability to execute against them. However, the proposal is also predicated upon a hardware development effort. The team seems impressive in general, but major commercial hardware systems are not listed as prior work. The timelines for prototyping and then re-engineering the hardware system in particular, especially while tackling a software-development process in parallel, seem awfully tight. In light of this, to be delivering a combined hardware/software solution all the way through to flight tests and a final report in 18 months seems a bit aggressive. Possible, but aggressive. Do not be surprised when timelines slip.

Reviewer 3B (Rating: 3)

The proposed approach is likely to achieve the objectives of this project. Drones could provide faster responses and better site monitoring, significantly enhancing current manual practices. Drones equipped with the right sensors could also improve accuracy, reduce field workers' potential hazards, and also reduce costs if deployed at a sufficiently large scale. Automated data-collection with drones combined with advances in AI/ML could lead to improved data-driven decision making, e.g., assist in predictive site maintenance. The application to wildlife monitoring (e.g., bird mortality assessments) is particularly compelling. This is of course assuming that obtaining an FAA operational waiver is feasible, which is hard for me to evaluate.

- 3. The quality of the methodology displayed in the proposal is: 1 – well below average; 2 – below average; 3 – average; 4 – above average; or 5 – well above average.**

Reviewer 1B (Rating: 3)

Their tools described in each task are industry standard.

Reviewer 2B (Rating: 4)

No comment

Reviewer 3B (Rating: 3)

The methodology seems reasonable, including initial domain selection, preliminary functional testing and prototyping, safety simulations and testing, customer site deployment, and final physical testing.

- 4. The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Renewable Energy Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.**

Reviewer 1B (Rating: 3)

While there appears to be other similar work ongoing, it is outside North Dakota.

Reviewer 2B (Rating:5)

North Dakota has significant potential renewable energy resources, particularly wind energy. If this proposed work is successful it could help both the development phase for new wind energy projects, as well as the operations of implemented wind energy projects, which would strengthen the economic value proposition of wind energy in North Dakota, and its role as a potential exporter of wind energy elsewhere in the ISO.

Reviewer 3B (Rating: 3)

This project would make the following scientific and technical contributions:

- Advance SRA-MDO capabilities, enhancing Safety, Wildlife Mortality Monitoring and Mitigation, Inspection, Maintenance, and Security aspects of Renewable Energy sites.
- Identify the strengths and limitations of SRA-MDO capabilities across several areas (hydroelectric, solar, wind) and demonstration to the FAA.
- Deployment and physical testing of drone-based solutions

5. The principal investigator's awareness of current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 1B (Rating: 2)

I did not see a discussion of competing research and commercial innovations.

Reviewer 2B (Rating: 4)

As this is more of a technical system development than a scientific endeavor, current research and published literature is less applicable here. However, the inclusion of the NP UAS TS as a partner gives some evidence that the burgeoning industry of automated drone monitoring (in areas like agriculture and real estate) are being considered and will inform the project.

Reviewer 3B (Rating:4)

Partnered with the University of North Dakota with rich research experiences in unmanned and autonomous systems, application and policy development, the PIs should be familiar with ongoing research activities in the field. Ashish Kapoor from Microsoft is a world-leader in this field. Thorough literature review should be done before commencing this project.

6. The background of the investigator(s) as related to the proposed work is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 1B (Rating: 5)

The investigators have recent and relevant successes in the area

Reviewer 2B (Rating: 4)

The various partner groups (NP UAS TS, Xcel, Microsoft) provide very impressive skills and backgrounds to assist a PI group that, while impressive, seems less experienced at these specific technical aspects (albeit seemingly strong on overall systems engineering). It was good to see more details on the Evolve team in this version.

Reviewer 3B (Rating: 3)

Key personnel have adequate track records and research/application experiences ranging from renewable energy and atmospheric sciences to aerial informatics and robotics.

- 7. The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and subcontractors, if any, is: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – very good; or 5 – exceptionally good.**

Reviewer 1B (Rating 1)

I just didn't understand it. I spent many hours on it.

Reviewer 2B (Rating:5)

All very clear. To get a better sense of the pragmatic approach I would wish to see more specific details for each of the segments of the software stack but that is probably not appropriate for this type of proposal.

Reviewer 3B (Rating: 4)

The proposed timeline starts from March 2019, and delivers by August 2020. A detailed timeline is provided and seems feasible. The management plan is reasonable:

- This project will be overseen by EvolveAnalytics
- There will be monthly meetings for monitoring progress and deliverables.

- 8. The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)**

Reviewer 1B (Rating:3)

The need the equipment and facilities they mentioned. They did not provide other data (cost, features) beyond a general description.

Reviewer 2B (Rating: 5)

No comment

Reviewer 3B (Rating: 4)

The proposed purchase equipment includes Microsoft Surface devices, stereoscopic sensors and drone hardware, chargers, including onboard processors. The equipment appears to be essential for testing the proposed approach.

- 9. The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.**

Reviewer 1B (Rating: 5)

There are first class hardware and software tools available and the team has noted them, and obviously spent time on researching their support tools. The facilities access is exceptional as well.

Reviewer 2B (Rating: 5)

Key partner groups bring strong-sounding facilities.

Reviewer 3B (Rating: 4)

This project requests a North Dakota Renewable Energy site as the main facility. This site is owned and operated by Xcel Energy. Once the criteria are established, representatives from UND, NPUASTS, EA, Xcel Energy, and Microsoft will jointly select the appropriate domain.

- 10. The proposed budget “value”¹ relative to the outlined work and the financial commitment from other sources² is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value. (See below)**

Reviewer 1B (Rating:3)

They have claimed to meet the rubrics of the program. I had difficulty validating and substantiating these claims.

Reviewer 2B (Rating: 5)

Significant additional financial resources are being provided by the partners, above 50% of the total project cost.

Reviewer 3B (Rating:4)

The details of budget allocation and justification are given in the proposal. The overall budget looks reasonable given the proposed timeline and objectives. Most of the budget is allocated to the technical division such as prototype engineering and software development.

¹ “Value” – The value of the projected work and technical outcome for the budgeted amount of the project, based on your estimate of what the work might cost in research settings with which you are familiar.

²Financial commitment from other sources – A minimum of 50% of the total project must come from other sources to meet the program guidelines. Higher priority is to be given if the application has private industry investment equal to or at least 50% or more of total cost.

Section C. Overall Comments and Recommendations:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 1B

I consider this a good idea, but with a difficult to understand project plan and budget. They seem to avoid delineating themselves from potential competitors. They are confident in their past experience, but my own experience running and approving projects like this is that past experience should be able to translate into clarity, and that is a clarity I did not see.

UAVs shouldn't be a solution looking for a problem. The anecdotes they used about manual labor processes (such as finding dead birds) weren't a closed comparison. For example, they said it may cost \$300K/year to inspect for dead birds on a wind farm, but there was no calculated/analyzed cost for doing it with a drone. Any financial investigator would call this out (I am a technical vs financial person). However, I use this example of an embedded bias in the report that surely UAVs can reduce costs. I have seen drone applications increase cost and decrease quality over manual processes. The rigor was lacking.

The project management didn't follow industry standards. I consider it the most substantial risk.

Reviewer 2B (Fund)

This is an improved proposal, with additional economic benefits more clearly spelled out, and more detail on the team. Some of the economic benefits suggested here seem aggressive, but at least the economic case is being made and can be refined as the system is tested in the field and provides more information on tangible benefits.

As mentioned above, I still have some concerns that this very software-centric team is taking on a hardware development project simultaneously. It may seem like simple hardware but in my experience it's wise to expect unanticipated delays in any hardware development process even by highly experienced teams, and I don't see a lot of that hardware development experience shown in the bios here. A successful hardware prototype will need to not only work correctly in its simple functions, it also will need to be integrated into the overall software system, it will need to be readily manufacturable, and it will need to hit cost targets.

However, the assembled partners here are very impressive, and this does intuitively seem like a good use case, especially in the North Dakota region. This would further the competitiveness of the ND wind industry and leverage strong local capabilities. Thus, based upon the limited information provided, I recommend to FUND the proposal.

Reviewer 3B (Fund)

This proposal aims at developing an autonomous drone-based system for monitoring the North Dakota renewable energy sector. It has the potential to reduce cost, potential hazards while at the same time increasing accuracy with the help of data science and drone sensors. The proposed objectives are reasonable and likely to be achieved. The proposal could make important contributions to site management in the renewable energy sector.